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ABSTRACT

Using techniques of inference appraisal suggested by T. A. van Dijk and R. J. Sternberg, a study investigated whether by assigning particular writing tasks it would be possible to influence the way readers produce inferences about a text. Subjects, 52 ninth grade students, read especially prepared booklets and completed either a paraphrasing, comparing/contrasting, or question formulating writing task. Students in a nonwriting control group engaged in matching exercises. The effects of the different tasks were observed in students' subsequent writings on an assigned topic related to their reading and on a forced choice analogies test. The results showed that writing in conjunction with reading did affect inference production and that differential effects occurred across variant writing tasks. Results suggest that formulating questions in response to a text might result in more restrained discourse production in subsequent reading/writing tasks, and that writing in general may extend thinking involved in probing for the discovery of promising relationships in the solution of abstract problems. (FL)

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Effects of Selected Writing Tasks Upon the Transfer of Prose Learning

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A growing body of literature in education and psychology advocates combining writing with reading as a profitable study technique. Page (1974), Bruce and associates (1978), Kintsch and van Dijk (1978), Flower (1979), and others argue that when combined with reading, writing promotes comprehension and learning by having the reader identify significant information in the text and actively reflect on that information as it is organized into a coherent written response. Eanet and Manzo (1976) and Odell (1980) further claim that by varying the writing task in response to reading, a teacher can alter the way students think about the content of a text.

Empirical support for these arguments remains sparse, although some evidence for the instructional value of coupling writing with reading has been reported in recent years by Bretzing and Kulhavy (1979), Doctorow, Wittrock, and Marks (1978), Taylor and Berkowitz (1980), and Taylor (1982). Reliable evidence has yet to be produced that can support the notion that variant writing responses differentially effect learning from text. Eanet (1978) does report that she successfully taught students to write certain types of annotations for prose materials but that writing the annotations did not differentiate students on measures of recall and comprehension from students who did not write annotations.

Method

With techniques of inference appraisal suggested by van Dijk (1977) and Sternberg (1977), an attempt was made to determine whether by assigning particular writing tasks it would be possible to influence the way readers produce inferences about the content of a text. Three different writing tasks were compared for their effect on the inference production of 52 ninth-grade students. The three writing tasks compared were paraphrasing, comparing-contrasting, and formulating questions. There was a non-writing control condition that engaged students in matching exercises. The effects of these responses were observed in students' subsequent writing on the topic of mechanical advantage and in their performance on a forced-choice analogies test on simple machines.

Materials

In order to observe the effects of these tasks under conditions comparable for all, the tasks were simultaneously assigned to students

by means of booklets constructed so as to provide for the different responses to reading.

Prose passages were excerpted from a widely used ninth-grade science textbook (Heimler & Neal, 1975) and adapted so that they would be comparable in organization and readability. These excerpts included a 300-word passage on the use of machines, a 60-word passage on the concept of mechanical advantage, and four 150-word passages on simple machines: the lever, the inclined plane, the pulley, and the wheel-and-axle. Materials also included four sets of written directions for responding to each passage, a two-part matching exercise, and a forced choice analogies test, all developed by the investigators. These materials were assembled into booklets in four different combinations, each to correspond to one of the four treatment conditions.

Procedure

The students were given booklets according to their respective treatment group assignments and told that there would be phases of the activity when their classmates would be doing different tasks: While some students would be reading, others would be writing and still others would be doing a matching exercise. The students were told that they would be given oral instructions for much of what they were to do, but at times during the activity they would simply be told to read and follow certain directions printed in their booklets.

First, all students silently read the 300-word introduction to machines while the investigator read it aloud. Then they were directed to read a brief (60-word) passage on mechanical advantage. Following this reading, students were told to turn the page and without looking back write down what they knew of the meaning of MECHANICAL advantage.

This writing sample served to control individual differences in discourse production and as the covariate for analyzing their writing. As soon as the students ceased writing they were told to turn to the next page of their booklet and follow the directions written at the top. At this point, all students were still doing the same activity, here to carefully read a passage on the LEVER. Then the students were told to turn the page over and follow the directions on the top of that page. The PARAPHRASE group was directed to write down what they could remember of the lever passage, the QUESTION group to write down as many questions as they could make up for the passage, and the other two groups were directed to read and study a passage on the INCLINED PLANE.

Next, the PARAPHRASE and QUESTION groups followed written directions to read the passage on the INCLINED PLANE while the COMPARE-CONTRAST group followed directions to write down likenesses between LEVERS and INCLINED PLANES, and the control group followed directions to match the lever and inclined plane to a list of their characteristics. Then, while the paraphrase group paraphrased the passage on INCLINED PLANES and the QUESTION group wrote questions for it, the COMPARE-CONTRAST group wrote down differences between LEVERS and INCLINED PLANES. The control group did another matching exercise identifying examples of a list of implements as either levers or inclined planes.

All subjects then read consecutive passages on the PULLEY and the WHEEL-AND-AXLE and then following the investigator's oral directions, wrote down what they had just read about those two simple machines. Here there were no directions to write questions or likenesses and differences, just to write about the pulley and the wheel-and-axle. This served two purposes. One purpose was to find out whether students

would continue to write questions or comparisons and contrasts or in some other way distinguish their writing systematically according to treatment condition. A second purpose was to provide a buffer between treatment activity and the dependent measure which entailed writing.

All students were then directed to discuss in writing the meaning of MECHANICAL ADVANTAGE. When all students ceased writing, they were introduced to a forced-choice analogies test on SIMPLE machines. Students were told not only to circle the item that best completed each of 10 comparison statements but to draw an X through the second best choice. Two examples were completed with the students in order to make sure everyone understood how to proceed.

Results and Discussion

Students' written work and test performance were analyzed so as to shed light on transactional operations thought to link reading and writing. Written responses to the texts on simple machines, written discussions on the theme of mechanical advantage, and performance on the analogies completion test were examined for qualities distinctly associated with treatment conditions.

Students' written responses to the texts on simple machines were examined to find out whether the assigned writing tasks would elicit differential amounts of discourse production. Protocols were examined according to a system of text analysis suggested by Kintsch (1974) for appraising the micropropositional content of a text. A count of micropropositions given in response by each assigned writing task revealed no significant differences across the tasks of paraphrasing $\bar{X} = 15.33$, formulating questions $\bar{X} = 13.67$, and noting likenesses and differences $\bar{X} = 14.25$. Comparability in amount of

writing elicited in response to the first two passages indicates on subsequent tasks differences associated with treatment would likely be due to influences other than amount of rehearsal afforded by the treatment.

Responses to the third and fourth passages on simple machines, the buffer passages, were examined for a carry-over of response set from the first two passages on simple machines and for an immediate transfer effect to closely related passages. Lacking directions as to how specifically to respond, subjects of all groups tended to respond in paraphrase form. Students who had written questions for the first two passages did not continue to write questions; nor did students who had written comparison-contrast statements for the first two passages continue to list likenesses and differences. It was noted, however, that students who had responded to each passage immediately upon reading it, i.e. the paraphrase and question groups, framed their responses somewhat differently than students who had read both the first and second passages passages before responding, i.e. the compare-contrast and matching groups. Students who had initially responded to each of the first two passages separately positioned their responses to the third and fourth passages separately. Students who had responded to the first two passages together positioned their responses to the third and fourth passages together. Apparently, students who had responded to the first two passages separately continued to approach successive passages separately, whereas students who had responded to the first two passages together viewed the third and fourth passages as constituting a pair of texts to which to respond. Since students in all groups tended to

respond to the topics of the third and fourth passages separately, the significance of differential positioning of response to these passages remains questionable. Of greater significance perhaps was a difference observed in the amount of information generated in response to the third and fourth passages. On these two passages, students who had formulated questions generated significantly fewer micropropositions, $\bar{X}$ = 11.25, than the paraphrase students, $\bar{X}$ = 17.50, the compare-contrast students, $\bar{X}$ = 17.40, and the matching students, $\bar{X}$ = 15.40, $F(3,48) = 2.83$, $p < .05$. This finding suggests an immediate transfer effect associated with responding to a text by writing questions, namely that amount of information given in a written response to a subsequent text is diminished.

This result adumbrated the finding for overall amount of information generated in discussion of the thematic superconcept mechanical advantage. Students who had formulated questions generated significantly fewer micropropositions, $\bar{X}$ = 6.58, than the phraphrase students, $\bar{X}$ = 9.10, the compare contrast students, $\bar{X}$ = 8.29, and the matching students, $\bar{X}$ = 10.49. These data were subjected to an analysis of covariance, the covariate being the number propositions generated in the initial writing on mechanical advantage. The analysis of covariance disclosed a difference for the question writing students, reliable to the extent that such a difference could be replicated more frequently than nine out of ten times, $F(3,47) = 2.52$, $p < 1$. The transfer effect on quantity of writing did not appear to wash out. Students who had formulated questions continued to be reserved in their production of written language. Perhaps students who wrote questions assumed a more deliberate approach. Perhaps they become more careful or formalized in their writing. Or perhaps they experienced a shift in orientation

to writing that limited the amount of information they generated. Information processing theorists Coleman (1964), Gough (1965), Fodor and Garrett (1967), Frase and Washington (1971), and others maintain that less information is understood per unit of time in responding to nonactive voice constructions, which include questions, because more language transformations are undertaken. A corollary to this notion is that formulating questions involves more and different language transformations than paraphrasing or noting likenesses and differences and that once the mechanism for making these language transformations is firmly established, it is maintained in subsequent writing tasks.

If this mechanism involves cognitive operations suggested by van Dijk (1977), a concomitant difference should be observed in the reader-based inferences generated in this task. In order to ascertain the proportion of reader-based inferences generated in the students' recalls a template text base was prepared for the brief passage on mechanical advantage according to procedures detailed by Turner and Greene (1977) and explained by Kintsch (1974). Each protocol was scored by comparing it to the template text base and examining the degree of similarity between the two. The micropropositions of each protocol were compared to those of the template text base and identified as either reproducing micropropositions of the template text base or representing inferences generated by the reader-writer. The proportion data on reader-based inferences identified in this way were subjected to an analysis of covariance, which controlled the effects of individual differences by covarying on the proportion of reader-based inferences generated in the initial writing on mechanical advantage. The analysis of covariance on the proportion data provided no evidence that reader-based inferences

were produced differentially across treatment conditions, $F(3,47) = 1.15$, n.s. Thus cognitive operations posited by van Dijk were not shown to be associated with their diminished discourse production of students in the question writing group.

The check on amount of information produced by the question writing group was not reflected in their performance on the analogies test. On this test, students who had written questions did not differ from students in the other writing groups. Students' performance on the analogies test was interpreted in light of Sternberg's (1977) theory of analogical reasoning, i.e. that level of inferential thinking can be determined according to the extent to which knowledge categories can be discriminated and relations educed in solving analogy problems. By having students indicate both their first and second choices for solving analogy problems, it was possible to estimate the extent to which their inferential thinking extended in discriminating information and educing relations. Correct best and second-best choices combined reflected students' ability to broadly discriminate categories of information sufficient to achieve mapping a domain of related terms into a range of other terms. Mapping does not require distinguishing classes of information from their constituents. The data indicate that students in the writing groups did not differ in discriminating information for mapping into a range, $\overline{X} = 10.08$ for paraphrase group, $\overline{X} = 10.07$ for question group, and $\overline{X} = 10.85$ for the compare-contrast group. However, all of the writing groups outperformed the matching group, $\overline{X} = 7.00$, $F(3,48) = 5.10$, $p < .01$ Students in the matching group appeared to be more random in their attempts to identify analogously related terms, thus demonstrating less systematic probing into the range for possible correlational fits.

By observing best choices only, an attempt was made to see if within the range categories identified as correlates of domain categories students could make further discriminations and educe appropriate relations. This data indicate no significant differences across treatments, $\overline{X}$ = 5.20 for the paraphrase group, $\overline{X}$ = 5.85 for the question qroup, $\overline{X}$ = 6.00 for the comprare-contrast group, and $\overline{X}$ = 5.23 for the matching group. The systematic difference observed for mapping without a difference observed in application of the final term supports the notion of sequence and hierarchy in analogical thinking. Apparently, application of the final term occurs further along in the sequence of cognitive events and higher in the hierarchy of cognitive operations.

Conclusion

The findings of the present investigation suggest that writing in conjunction with reading does affect inference production and that differential effects may be expected across variant writing tasks. The findings suggest that formulating questions in response to a text may result in more restrained discourse production in subsequent reading-writing tasks, and they suggest that writing in general may extend thinking involved in probing for the discovery of promising relations in the solution of abstract problems. Given the exploratory nature of this investigation, the findings should be considered promising. Further research which improves upon the methodology of the present effort should yield results which ultimately will permit more refined distinctions in the instructional uses of writing in response to reading.

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